Accelerating energy efficiency in China's existing commercial buildings

Part 2: Solutions and policy recommendations

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Acronyms and Abbreviations

BOMA	Building Owners and Managers Association
CABEE	China Association of Building Energy Efficiency
DOE	U.S. Department of Energy
EMCA	Energy Management Company Association
ESCO	Energy Service Company
EPC	Energy Performance Contracting
IFC	International Finance Corporation
IRR	Internal Rate of Return
MOHURD	Ministry of Housing and Urban-Rural Development of China
M&V	Measurement and Verification
NDRC	National Development and Reform Commission of China
PG&E	Pacific Gas and Electric
SCE	Southern California Edison
SME	Small-to Medium-Sized Enterprise

Executive Summary

Accelerating Energy Efficiency in China's Existing Commercial Buildings – Part 2: Solutions and Policy Recommendations (Part 2, for short) discusses potential policy solutions that can tackle the barriers of the Chinese building energy efficiency market. Those barriers were identified in *Accelerating Energy Efficiency in China's Existing Commercial Buildings – Part 1: Barrier Analysis* (Part 1).

Many energy service companies were established due to government policies and subsidies that favored them during the Twelfth Five-Year Plan (FYP). Those companies now serve as the main market driver for building energy efficiency retrofits in commercial buildings, except for government-mandated energy efficiency upgrades in government buildings. Barriers exist because stakeholders other than energy service companies, such as building hosts and financial institutions, are not sufficiently motivated to retrofit buildings.

Part 1 described barriers facing building energy efficiency upgrades for various stakeholders such as energy service companies, privately owned commercial building hosts, government-owned public building hosts, property management companies, measurement and verification (M&V) companies, government, and commercial banks. Barriers are summarized by stakeholder group below.

Barriers facing key stakeholders:

Energy Service Companies (ESCOs)

Building energy efficiency-focused ESCOs with limited growth potential

- High transaction cost: a burdensome customer acquisition process
- Untrustworthy hosts that add financial risks for ESCOs
- Difficulty gaining third-party financing from commercial banks to cover project capital

Privately owned commercial building hosts

- Split incentives
- Lack of motivations from hosts

Government-owned public building hosts

- Energy costs are a part of the government budget. However, there is no motivation to invest in building energy efficiency upgrades, because government agencies are not interested in having a decreased budget in the upcoming year.

Property management companies

- Lack of technical capability
- Lack of motivation by individual property managers, because conducting energy efficiency upgrades are not considered in their performance reviews

Measurement and verification (M&V) companies

- Lack of a comprehensive whole building M&V protocol

- To please potential customers, M&V companies might exaggerate energy saved resulting from energy efficiency retrofits.
- Inadequate quality control for M&V companies' results

Government

- As designed currently, in the privately owned building energy efficiency market, subsidies and grants are given to energy service companies only, which does not motivate other stakeholders.
- Inter-agency government policies are generally lacking.

Commercial banks

- Commercial banks' loan service and ESCOs lending request are mismatched.

For privately owned commercial building retrofits, incentive policies and programs are primarily designed to encourage ESCOs. Those incentives are typically in the form of government subsidies. Therefore, for privately owned commercial building retrofit projects, ESCOs are the main drivers of energy efficiency upgrades, and they engage other stakeholders, including building hosts, financial institutions, property managers, and M&V companies. It is a difficult business for ESCOs because other stakeholders are not motivated enough.

For publically owned government building retrofits, policies and programs are primarily designed to encourage hosts, such as the voluntary building energy efficiency Top Runner program (NDRC, 2015). Government building hosts can apply for grants from government agencies to conduct building energy efficiency upgrades. In this case, government building hosts become the main driver and engage other stakeholders, including equipment vendors and ESCOs.

In building energy efficiency upgrades for both privately owned commercial buildings and publically owned government buildings, not all stakeholders are properly incentivized, which causes barriers. It is important to create a healthy business ecosystem with strong stakeholder motivation on each side.

Summary of recommendations for addressing the barriers:

- **Solutions to motivate hosts**

Create policies or programs that encourage or incentivize hosts to procure energy efficiency upgrades. Educate hosts about building energy efficiency upgrades. Provide connections to the right financing providers and building energy efficiency service providers.

> **How it addresses barriers:** Creating a supportive business environment for hosts motivates them to take actions and engage in building energy efficiency, which in turn reduces energy service companies' customer acquisition burden, and helps to scale the market. Third-party financing has been difficult for the building energy efficiency market. When a building owner is the energy efficiency lender instead of the energy service company, financial institutions are more interested in providing a loan, because a building host often has a substantial asset, and can provide the collateral that banks require. Light-asset energy service companies cannot provide that.

- **Solutions to motivate property management companies**

Build a supportive policy ecosystem to motivate property management companies. Promote new energy saving business model where property management companies, such as Property Energy Management (PEM), are the main drivers.

How it addresses barriers: Motivating property management companies to retrofit buildings transforms them from passive participants to active market drivers. As the crucial intermediary between ESCOs and hosts, the active participation of a property management company helps to overcome some split incentives barriers and helps to scale-up building energy efficiency retrofits.

- **Solutions to motivate financial institutions to provide suitable energy efficiency project loans**

Build a supportive policy ecosystem to provide a supporting mechanism for financial institutions to lower risks and improve return on building energy efficiency projects.

How it addresses barriers: Lowering risks for financial institutions motivates them to provide loans to building energy efficiency projects. Sufficient third-party financing helps to scale-up building energy efficiency retrofits.

- **Suggestions for comprehensive government policy**

Design innovative interdepartmental government policies by encouraging "smarter" government spending, in addition to subsidies and grants, that can effectively promote building energy efficiency upgrades. Government should create new laws to support energy efficiency upgrades, and encourage data transparency. Take advantage of the ongoing electricity reform and encourage business models that relate to building energy efficiency upgrades.

How it addresses barriers: By engaging in other types of government spending, in addition to subsidies such as those for public–private partnerships, governments can effectively bolster private spending to scale-up building energy efficiency projects. Creating laws or regulations such as data disclosure also helps to scale-up building energy efficiency projects. Data transparency helps to mitigate the difficulty of not being able to access data and to verify energy saved through energy efficiency improvements. Increasing interdepartmental collaboration within government agencies helps to create more comprehensive policies that are covered by different government agencies. The ongoing electricity market reform, where an electricity retailer might be able to engage with an energy service company to implement building energy efficiency, also creates additional opportunities for energy service companies and for motivating hosts.

- **Standardize building energy efficiency projects**

Standardization of building energy efficiency projects helps to create standardized M&V protocols, and assists commercial banks in assessing building energy efficiency financing loans efficiently and to scale.

How it addresses barriers: Each building energy efficiency project is unique. No action has been taken to categorize those projects so they may be standardized by retrofit types. Doing so would help commercial banks access financing quickly and at scale. Standardized projects also help governments create programs that can be suitable for each category.

1 Introduction

Accelerating Energy Efficiency in China's Commercial Buildings – Part 2: Solutions and Policy Recommendations (Part 2) discusses potential policy solutions that can be used to tackle the barriers to a successful Chinese building energy efficiency market. Those barriers were identified in *Accelerating Energy Efficiency in China's Commercial Buildings – Part 1: Barrier Analysis* (Part 1). This chapter summarizes the barriers to building energy efficiency upgrades and selected solutions to overcome those barriers that have been implemented in the United States from Part 1; it then discusses the purpose of this report, its research methodology, and its organization.

1.1 Building energy efficiency barriers identified in Part 1

More energy service companies were established due to favorable government policies and subsidies for energy service companies during the Twelfth Five-Year Plan (FYP). Those companies now serve as the main market driver for building energy efficiency retrofits in commercial buildings, except for government-mandated energy efficiency upgrades in government buildings. Barriers exist because stakeholders other than energy service companies, such as building hosts and financial institutions, are not sufficiently motivated to retrofit buildings.

1.1.1 Stakeholder barriers identified in Part 1

Part 1 reported results of engaging relevant stakeholders involved in building energy efficiency. Two rounds of in-person interviews were conducted with relevant stakeholders in China, including ESCOs, hosts, property management companies, measurement and verification (M&V) companies, governments, and commercial banks. Stakeholders' barriers are summarized in Table 1.

Table 1. Stakeholder barriers summarized in Part 1

Stakeholder/Barriers	
Energy Service Companies: Companies that provide energy performance contracting (EPC) to the building hosts.	
Building energy efficiency-focused ESCOs have limited growth potential	Building energy efficiency companies are mainly small- and medium-sized enterprises (SMEs). Those SME ESCOs have difficulty competing for large industrial energy efficiency projects with large ESCOs, while large ESCOs consider building energy efficiency projects to be too small, and they are unwilling to tap into the market. As a result, building energy efficiency companies remain small and find it difficult to survive.

The customer acquisition process is burdensome	Building energy efficiency is a low entry barrier business; as a result, the building energy efficiency market is not only full of small- and medium-enterprises, it is very competitive. The customer acquisition process is very burdensome because it requires each building energy efficiency ESCO to design and propose potential solutions for potential customers (building hosts) before they are even hired. It is very common for customers to not choose an ESCO even after all its customer acquisition efforts have been made.
Untrustworthy hosts	Not all buildings hosts are trustworthy. Some hosts might not pay ESCOs their fee, for example, due to a savings dispute. Another example is a host that defers or cancels payments due to high staff turnover.
Difficulty gaining third-party financing from commercial banks	To scale-up the building energy efficiency market, it is imperative to obtain sufficient project funding. Difficulty in gaining third-party financing has been identified as a key inhibitor to the growth of the building energy efficiency market. This is not true just for ESCOs; small- and medium-sized enterprises experience difficulty in obtaining bank loans in general. For large ESCOs, bank loan interest for building energy efficiency project financing is too high, making lending not cost-competitive.
Privately Owned Commercial Building Hosts: Buildings that are owned by private commercial entities	
Split incentives	In a single building, occupants, property managers, and owners have different priorities and interests. Building energy efficiency upgrades often only benefit those who pay utility bills (for example, building occupants), but those who have the right to conduct a building energy efficiency upgrade (for example, building owners) do not necessarily pay utility bills.
Lack of motivations from hosts	Split incentive issues are one reason hosts are less motivated to participate in building energy efficiency retrofits, but research also identified that hosts do not consider building energy efficiency upgrades their priority, and that they have concerns over economic return, safety, or disturbance in operation.
Government-Owned Public Building Hosts: Buildings that are owned or operated by public entities.	
Budget utility cost structure that decreases hosts' motivation in building	For government-owned public buildings, utility costs are covered in the form of a budget proposal, where the upcoming years' budget to cover utility costs are determined by past years' utility costs. The reduction of building energy use actually results in a decrease in

energy efficiency upgrades	the upcoming years' total budget. Government-owned public buildings do not prefer a shared saving model, because it creates additional complications on the balance sheet.
Property Management Companies: Property management companies manage the daily operation of buildings or a building complex.	
Lack of technical capability	Property management companies often lack trained technical professionals that have an accurate understanding of building's mechanical and electrical systems.
Lack of motivation by individual property managers	Individual property managers are paid fixed a salary. Reducing a building's energy use or energy costs or implementing a building energy efficiency upgrade is often not a consideration in a property manager's performance review, therefore, those individuals are not motivated to so implement energy efficiency.
Measurement and Verification (M&V) Companies: M&V companies provide measurement and verification of building energy saved as a result of a building energy efficiency upgrade.	
Lack of a comprehensive M&V protocol	Current M&V protocols or standards in China only consider energy saved as a result of an individual building energy efficiency technology upgrade, and do not consider the interaction of energy efficiency technologies.
Conflict of interest	Often, ESCOs pay for M&V companies to produce savings reports. M&V companies often provide factitious energy savings numbers only to satisfy their customers' (ESCOs) request, instead of actual energy saved.
Inadequate quality control for M&V companies' results	In the past, the accuracy of M&V companies' results had been questionable, partially due to conflict of interest. The General Administration of Quality Supervision, Inspection and Quarantine (GAQSIQ) considers building energy saving M&V to be a service, and it has no control over a low-quality service.
Government: Governments set up targets, policies, and mandates that support energy efficiency upgrades, and promote mandatory or voluntary programs to encourage building energy efficiency upgrades.	
As designed, subsidies and grants have loopholes	The current building energy efficiency market relies heavily on subsidies and grants. Currently, little enabling legislative support is available in addition to those subsidies.
Interdepartmental policies are lacking	Interdepartmental policies are also lacking within the government, due to conflict of interests between government entities.

Commercial Banks: Commercial banks are the most common project-financing channel for building energy efficiency projects.	
Commercial banks' loan services and ESCOs lending requests are mismatched	Even though commercial banks are the most common project financial channel for building energy efficiency projects, relatively small numbers of loans have been lent. Banks like a low-risk, heavy-asset, high-financial reward, and large-size standardized product, but SME building ESCOs are considered to be high-risk and light-asset, and building energy efficiency projects are low-financial reward and small unstandardized projects. Large building ESCOs that banks will lend to would prefer a low-interest loan, but because building energy efficiency projects are categorized as higher risk, interest rates for project financing are higher than ESCOs would prefer.

1.1.2 Key barriers identified by each of the stakeholders are summarized below. Overarching barriers identified in Part 1

Overarching barriers were also identified in Part 1. These include a low internal rate of return for a deep building energy efficiency retrofit project, as well as a lack of creditworthiness and lack of systematic diagnostics, planning, and market consolidation.

1. Building energy efficiency's internal rate of return is too low for deep retrofits

In general, the building energy efficiency improvement market in China is not very profitable. After the building energy efficiency low-hanging fruit, such as lighting replacement, is harvested, the internal rate of return (IRR) for deeper energy retrofit projects (such as heating, ventilation, and air conditioning [HVAC] replacement or building envelope improvements) is relatively lower and does not attract building energy efficiency ESCOs. Government subsidies have been used in the past to encourage deep building energy efficiency retrofits, but with decreased government subsidies, ESCOs have also decreased their interest in conducting deep retrofits for customers.

2. Lack of creditworthiness hinders sector growth

China lacks a comprehensive credit system, which hinders a host's ability to identify trustworthy ESCOs, an ESCO's ability to identify trustworthy hosts, and financial institutions to identify trustworthy borrowers.

3. Lacking systematic diagnostics, planning, and market consolidation

Building energy efficiency upgrades are often not done systematically; rather, they are often an unorganized series of individual technology upgrades performed when they are the easiest or necessary to implement. Individual building hosts also have difficulty distinguishing services

provided by ESCOs. After a building energy efficiency retrofit, operational issues also can arise, but at that point in the process, building operators pay less attention to how to manage and maintain the equipment, which results in the building system not performing optimally.

1.2 Common U.S. solutions to overcoming building energy efficiency upgrade barriers identified in Part 1.

In Part 1, the U.S. building energy efficiency market was used as an example to show building energy efficiency barriers that currently exist in the U.S. market and some solutions used to address those barriers. The building energy efficiency market in the United States is much more mature compared to that in China, but still barriers exist. Key barriers in the U.S. market come from two sources: (1) the lack of motivation by building hosts to conduct building energy efficiency upgrades, and (2) lack of access to high project financing capital. Federal, state, and municipal governments in the United States have all designed building energy efficiency programs or mechanisms to overcome those barriers. Solutions are summarized below:

Barrier 1: Lack of motivation from building owners

Description: Generally, building owners lack interest in building energy efficiency upgrades. This especially applies to privately owned building owners. Some government agencies are mandated to retrofit their buildings.

Solution 1: Benchmarking

Certain state and municipal governments in United States have designed benchmarking and data disclosure policies that require a building owner's energy data, to raise building owners' awareness on building energy use, and encourage building hosts to decrease their energy usage. So far, benchmarking and data transparencies policies have been adopted by 8 states and 14 cities across the United States (Schwartz, et al., 2017; NYC Mayor's Office of Sustainability, 2017).

Solution 2: Incentives and Rebates

Government agencies, as well as utilities such as Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and Green Mountain Power design energy efficiency programs and provide incentives, tax deductions, or rebates to encourage building energy efficiency upgrades by owners.

Solution 3: Rate Design with pricing signals

Creating electricity price signals such as tiered rates, demand charges, and time-varied pricing encourages users to reduce energy usage or increase investment in energy efficiency.

Barrier 2: Difficulty gaining energy efficiency financing

Description: Difficulty gaining third-party financing is another issue in the United States that inhibits the growth of building energy efficiency upgrades. Innovative financing mechanisms aim to break down financing barriers.

Solution: Financing product innovation

Innovative financing products have been designed by financial institutions, utility companies,

and policy makers to encourage increased project financing in building energy efficiency. Key financing innovations include on-bill financing, property assessed clean energy (PACE) programs, and saving-backed arrangements. Governments have also designed special revolving funds specifically for building energy efficiency projects.

1.3 Purpose of this research

Part 2 aims to bring potential policy solutions to tackle the barriers to the Chinese building energy efficiency market identified in Part 1. Past research studies did not systematically study the barriers that inhibit the growth of building energy efficiency implementation and search for solutions to address those barriers. Part 2 introduces solutions identified through interviews with stakeholders and literature review, and focuses on those that are only applicable to China. The purpose of this research is to provide to Chinese decision makers and relevant stakeholders with a solution package they can consider to scale-up building energy efficiency upgrades.

1.4 Methodology and data sources

For Part 1, structured in-person stakeholder interviews were conducted to identify barriers facing building energy efficiency in China. After the structured interviews, informal discussions were held to discuss potential solutions that could be used to overcome those barriers. Stakeholders involved in the interviews included: ESCOs, hosts, property management companies, governments, and commercial banks.

In addition to the in-person stakeholder interviews, a literature review was conducted to search out the current best practices in both the United States and China that could address barriers identified in Part 1.

1.5 Paper organization

This report lists and summarizes specific solutions that address specific barriers. Each solution is expanded with a case study to illustrate how it could help to address specific barriers.

Chapter 2 expands each of the solutions identified with case studies that illustrate in detail and how those solutions could be implemented and how they would be able to overcome barriers.

Chapter 3 summarizes solutions identified from the literature review and case studies and specific barriers that they can overcome.

Chapter 4 concludes the solutions and findings.

2 Solution Descriptions with Program and Policy Examples

Part 1 suggested the importance of creating a healthy building energy efficiency business ecosystem where each stakeholder is motivated. This chapter will discuss potential solutions that motivate each stakeholder, including hosts, property management companies, banks, and governments.

2.1 Recommended solutions to encourage hosts' participation

In the United States, many programs incentivize hosts to participate in energy efficiency upgrades. Those incentives include providing energy efficiency upgrade rebates through utility company programs and receiving third-party financing solutions (IFC, EMCA, 2017). For example, the U.S. Department of Energy's (U.S. DOE's) Better Buildings Initiative is a government program that aims to provide resources and education to building hosts, to help them make the best decisions on building energy efficiency upgrades, choose the most suitable energy service provider, and receive attractive financing from financial institutions (U.S. DOE, 2017a).

Learning from the U.S. experience, the author illustrates a hypothetical host-market driven building energy efficiency market structure that might apply to the market in China (Figure 1). In this structure, hosts initiate a request for a building energy efficiency upgrade and request loans from third-party financing. After the building energy efficiency upgrade is conducted, the host can engage with a third-party M&V company and request subsidies to the government directly. For host-oriented incentive programs to be more successful, it is important to educate building owners and property management companies.

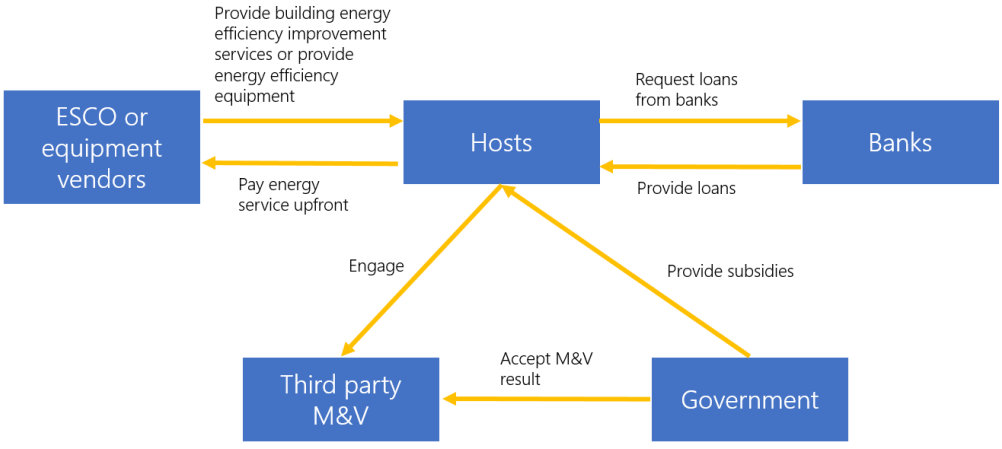

Figure 1. Example of a hypothetical host-market driven building energy efficiency market model

Program Example: The U.S. Better Buildings Challenge Initiative

The U.S. Department of Energy's Better Buildings Challenge Initiative was initiated in 2011. It provides public recognition to building owners who voluntarily reduce their building portfolio-wide energy usage by 20% within 10 years. The initiative aims to engage building owner interest in energy efficiency upgrades by providing technical training to managers to tackle market barriers. In addition, the Initiative provides training materials for financing options and provide building owner a list of financing partners. By 2016, over 300 partners had joined the Better Buildings Initiative, and their efforts resulted in energy cost savings of more than $1.3 billion (U.S. DOE, 2017a).

The Better Buildings Challenge Initiative is a successful example of how U.S. policy makers motivate building owners to participate in building energy efficiency improvement. In 2017, Lawrence Berkeley National Laboratory's China Energy Group began to work with the China Association of Building Energy Efficiency (CABEE) to bring the U.S. Better Buildings Initiative to China. The China Better Buildings Challenge Initiative aims to motivate building hosts to initiate building energy efficiency upgrades by providing recognition and supporting mechanisms.

2.1.1 Host information awareness

Barriers it addresses: *Hosts need increased motivation to conduct building energy efficiency retrofits.*

It is imperative to educate hosts about building energy efficiency and increase their motivation to retrofit their building. Based on interviews and literature reviews, hosts often have difficulty understanding their building's energy saving potential, and many property management companies managing Chinese buildings do not have the proper building operation expertise (Xiao, Xu, & Fan, 2011; LBNL , 2017; Beijing Jiaotong University's property manager, 2017; EMCA, 2017).

2.1.2 Connect hosts with suitable energy service providers

Barriers it addresses: *Hosts need increased motivation to conduct building energy efficiency retrofits, which will help to reduce the burden on the energy efficiency service providers to acquire customers.*

A certification and rating system for ESCOs also helps hosts identify qualified energy service providers, which alleviates their concern over ESCO suitability and accountability (EMCA, 2017). Third-party organizations, such as the ESCO Committee of China Energy Conservation Association (EMCA), could help hosts identify credible ESCOs by providing an ESCO rating system based on service qualities, size, and other criteria (EMCA, 2015).
The U.S. Better Buildings Initiative offers webinars so that building hosts can learn about

different building energy efficiency approaches. The training helps building hosts to identify their energy saving potential and choose suitable energy service providers (U.S. DOE, 2017a).

2.1.3 Connect hosts with suitable third-party financing to conduct deep retrofits

Barriers it addresses: *Building energy efficiency third-party financing has been difficult.*

Connecting hosts with suitable third-party financing would increase their motivation to retrofit their buildings. As noticed in China, it is very rare for hosts to request a loan from banks to conduct an energy efficiency retrofit. Banks also indicated that it is mainly ESCOs that come for loans. In the United States, it is already very common for hosts to initiate the loan process, which mitigates the host's financial burdens to pay retrofit costs all upfront, and also mitigates the ESCO's financial burden in the shared saving model (Schlein, Szum, Zhou, Ge, & He, 2017).

In the U.S. Better Buildings Initiative, the online Financing Navigator tool (Figure 2) helps building hosts find third-party financing that is suitable for their retrofit purposes (U.S. DOE, 2017a). A detailed introduction and user-friendly interface quickly helps potential hosts find suitable financing solutions.

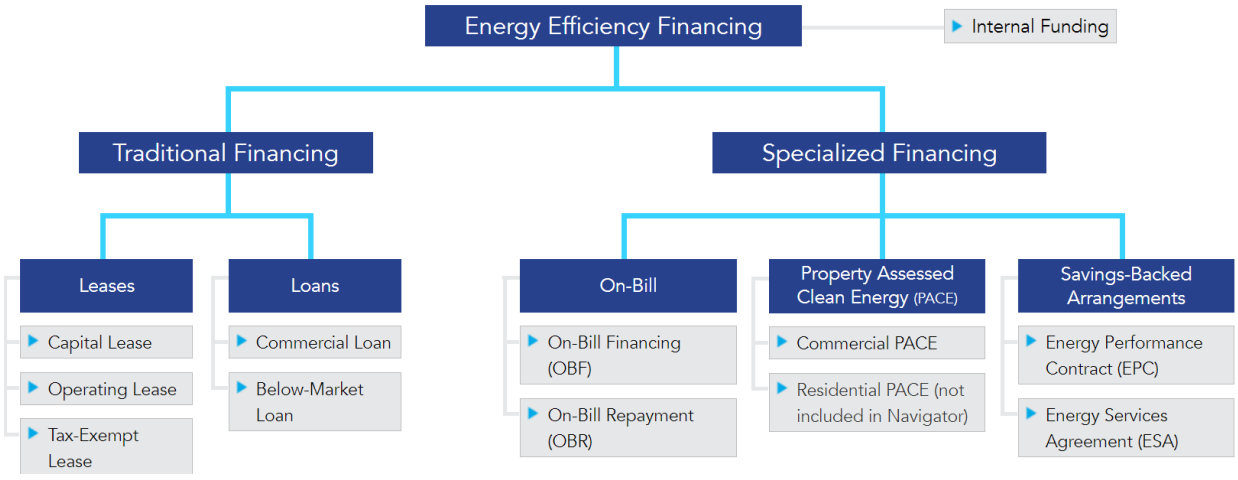

Figure 2. Types of energy efficiency financing in the Better Buildings Initiative's Financing Navigator tool (U.S. DOE, 2017a)

In China, financial products for host-oriented energy efficiency products are not yet prevalent. After those financial products become available, it is important to publicize them to the hosts in order to help them to find suitable financing products, which motivates host to conduct building energy efficiency retrofits.

Building hosts indicated in the interview they would prefer off-balance sheet financing (LBNL , 2017; EMCA, 2017; Beijing Jiaotong University's property manager, 2017). China policy makers could reference the U.S. DOE Off-balance Sheet Building Energy Efficiency Financing Program as a good example for potential off-balance sheet programs.

2.1.4 Utilize a consumer-driven approach to encourage energy savings

Barriers it addresses: *Hosts lack motivation to conduct building energy efficiency upgrades, and property management companies lack both the technical capability and the motivation to initiate building energy efficiency retrofits.*

Research shows that making energy usage visible to building owners or managers would increase their knowledge on building energy use and increase their motivation (Delmas, Fischlein, & Asensio, 2013). Unlike a consumer product, building energy efficiency is difficult to visualize. There is a lack of major advertising on the importance and benefits of building energy efficiency targeted toward building hosts, which makes building energy efficiency upgrades a "behind the scenes" activity (Delmas, Fischlein, & Asensio, 2013; Darby, 2001).

From a meta-study covering information strategies (i.e., bringing energy usage information to users) that encourage energy conservation behaviors, on average, individuals reduced their electricity consumption by 7.4 percent (Delmas, Fischlein, & Asensio, 2013). When combined with smart home appliances, these savings can be much greater (Zipperer, et al., 2013).

In public/commercial buildings, installing a building management system enables building managers and owners to visualize energy usage, which helps them better consider energy use reduction options. Some buildings might not have a building management system, but property managers welcome such a system because it reduces their workload by freeing them from the manual labor of controlling building systems (BOMA China , 2017).

For residential buildings, the smart thermostat company Nest (acquired by Google) has set an example of connecting building energy efficiency with coolness and user-friendly design, and has helped to make energy usage information visible to building owners. The smart thermostats have a stylish design and use machine-learning technology to automatically turn down room temperature when people leave the house and turn the temperature back up before people re-

Program Example: Off-balance sheet financing for U.S. academic instructions

The U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, in partnership with Virginia's Commonwealth Competition Council and New Jersey-based M/A Structured Finance Corp., developed a $50 million pooled financing pilot program for energy efficiency projects for academic institutions, including K–12 schools and publically owned colleges and universities. The program's purpose is to provide an off-balance sheet and procurement-friendly method to finance projects in public sectors. International Performance Measurement and Verification Protocol (IPMVP) guidelines allowed participating financing institutions to have a basis on energy saving, crucial for off-balance sheet financing. The IPMVP provides confidence and standardization that allow those pool funds to advance based on future pooled energy savings, with borrowing "off-balance sheet" for the academic institutions (IPMVP, 2002).

enter the room. Homeowners can recoup their investment in the thermostat from energy saved in about two months in cold winter regions, such as the northeastern United States. People did not necessarily buy the thermostats because they would save energy but because they looked cool. Huge roadside advertising banners featuring stylish Nest thermostats and reading "reinventing the unloved" make thermostats attractive as consumer products (Nest, 2017).

2.2 Building property energy management-oriented market design

Barriers it addresses: *Property management companies lack incentives and technical capabilities.*

Property management companies serve a crucial role in the entire business planning of building energy efficiency projects; increasing property management companies' interest in building energy efficiency is crucial to scaling-up the industry (Douglas, 1996; Turner, 2005). Two approaches motivate property management companies: (1) aligning incentives between property management companies with ESCOs and hosts, and (2) improving energy efficiency awareness and expertise (Xiao, Xu, & Fan, 2011).

2.2.1 Aligning incentives between property management companies with ESCOs and hosts

Barriers it addresses: *Property management companies lack incentives.*

Property management companies have natural synergies with building energy efficiency upgrades. From building diagnosis to construction and follow-up energy management, property management companies have to play a key role between host and ESCOs, regardless of the property management companies' interests (Energy Star, 2017). Therefore, if property management companies view building energy efficiency as a business opportunity instead of a potential burden, it would benefit property management companies and support the goal of having hosts conduct building energy efficiency upgrades (Zhang & Deng, 2016).

Figure 3 shows a potential model where property management companies take the initiative in building energy efficiency upgrades. The figure is extracted from *Energy Saving Management Mode of Commercial Buildings Based on Property Management* (Zhang & Deng, 2016). Property energy management (PEM) is a potential approach to incorporate building energy efficiency into property management, where property management companies serve an active role in implementing building energy efficiency. In this scenario, property management companies conduct building energy efficiency management and retrofits. With furious competition in the property management market, an added service such as energy management could help property managers distinguish their services from competitors and potentially gain additional customers (Xiao, Xu, & Fan, 2011).

By becoming the intermediary between the host and the ESCO company, a property management company could understand the hosts' needs and find the most appropriate

energy services to meet those needs. Property management companies could take on the "energy outsourcing" EPC model that serves as an "integrated service provider" to aggregate other ESCO services or individual equipment to provide comprehensive energy services for the hosts.

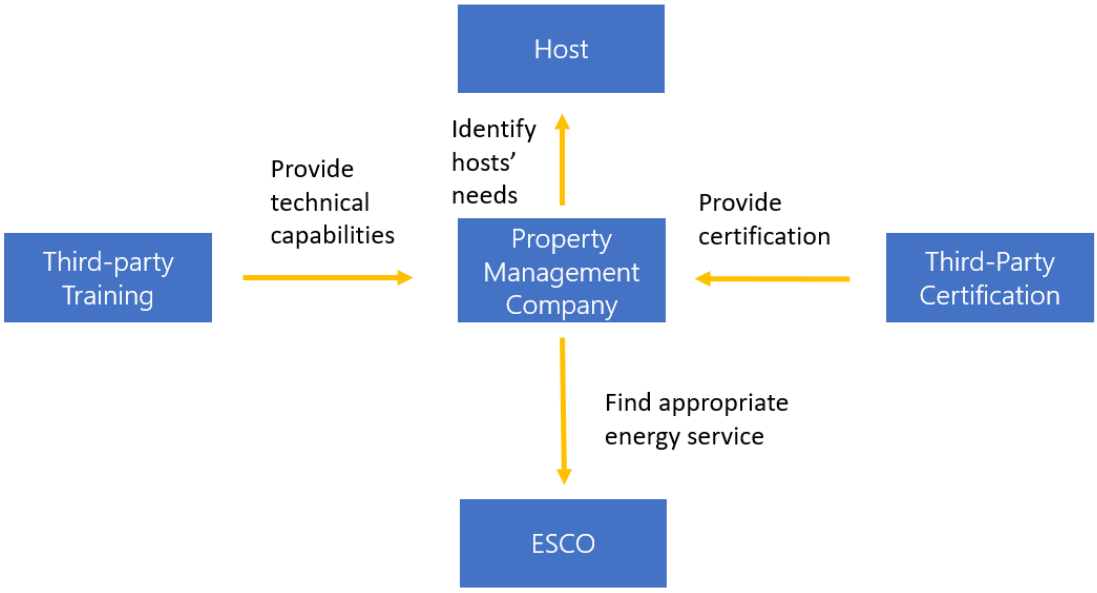

Figure 3. An EMC model where property management companies take the initiative (Zhang & Deng, 2016)

A certification program for property management companies that can provide energy efficiency services could help hosts to identify a proper property management service provider. The certification process can be initiated by third-party organizations, such as the China Property Management Institute under the Ministry of Housing and Urban-Rural Development (MOHURD) or property management organizations such as Building Owners and Managers Association International (BOMA). Hosts would be able to select certified property management companies if they intend to conduct a building energy efficiency upgrade.

In addition to motivating property management companies to enter the energy service market, ESCO companies have also expressed interest in entering the property management market, starting with energy management for hosts (Tongfang Taide, 2017).

2.2.2 Enhance property management companies' technical capability by improving energy efficiency awareness and expertise

Barriers it addresses: *Property management companies lack technical capability.*

Capacity building is the first step in creating property management companies that are qualified to provide energy services. For example, BOMA China helps to train property managers in their

organizations to provide services that are more professional by providing relevant trainings. BOMA also provides energy management services to its member property management companies (BOMA China , 2017).

2.3 Financial institution-oriented market design

Barriers it addresses: *Financial institutions lack motivation to provide project financing for building energy efficiency projects. Building energy efficiency providers encounter project financing difficulties.*

More than anything, commercial banks need to see a reduced risk associated with lending money for building energy efficiency projects (Blyth & Savage, 2011; Kats, Menkin, Dommu, & DeBold, 2011; UNEP Finance Initiative, 2009). Reducing a bank's risk will make it more willing to promote low-interest loans to building energy efficiency projects.
Ensuring banks that their loans will be repaid is the core barrier to overcome. Credit enhancement mechanisms would motivate banks to provide financial products for building energy efficiency (Blyth & Savage, 2011; Kats, Menkin, Dommu, & DeBold, 2011; UNEP Finance Initiative, 2009; Schlein, Szum, Zhou, Ge, & He, 2017; Sarkar & Singh, 2010). The authors offer the following suggestions for financial policies and tools that can help address barriers.

2.3.1 Insurance products

China is experimenting with the innovative concept of an energy efficiency insurance system, to help banks to guarantee their payback and greatly motivate them to lend to this industry. Insurance products can be designed to pay the banks or hosts if promised energy savings cannot be reached (Mo, 2016; Painuly, Park, Lee, & Noh, 2003). Figure 4 illustrates how an insurance product can complement commercial banks in decreasing risks for building energy efficiency financing. The Paulson Institute signed a memorandum of understanding of cooperation on green building insurance with People's Insurance Company (PICC) on March, 2017, to experiment with an energy efficiency insurance product (Paulson Institute, 2017). Since this collaboration was just initiated, this report will not discuss the outcome of the PICC insurance product.

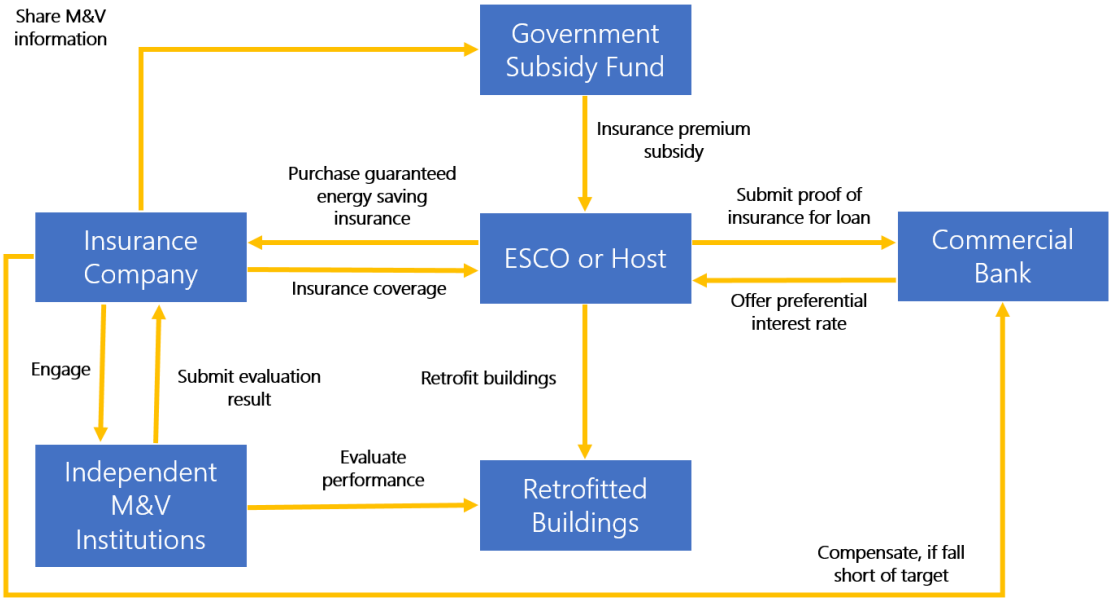

Figure 4. Example of how an insurance product can enhance credits for building energy efficiency financing, extracted from *Financing Energy Efficiency Buildings in Chinese Cities* (Mo, 2016)

2.3.2 Credit enhancement partnerships

Collaborating with other organizations to enhance credit for building energy efficiency projects is also an effective approach to mitigate barriers for third-party financing, with mechanisms such as loan loss reserve, or a government loan guarantee fund (Kats, Menkin, Dommu, & DeBold, 2011; ACEEE, 2017). The International Finance Corporation's (IFC's) China Utility-Based Energy Efficiency Finance Program (CHUEE), illustrated in the case study below, is an example of loan loss reserve.

Program Example: The IFC's CHUEE Program

In 2006, the International Finance Corporation (IFC) started the China Utility-Based Energy Efficiency Finance Program (CHUEE) with the aim of creating a loan loss reserve mechanism to encourage commercial buildings to provide loans to energy efficiency and renewable energy projects.

The CHUEE program partners with commercial banks and other financial institutions by providing technical advisories and risk-sharing mechanisms to cover commercial bank's defaulted loans. International collaboration includes the CHUEE's program to help enhance a building energy efficiency project's credit and reduce risk to banks (Chen, 2017). By 2015, the CHUEE program's partner banks provided loans worth over $625 million under the risk-sharing facilities by IFC, resulting in an estimated carbon dioxide (CO_2) reduction of 20 million tons (IFC, 2017).

Figure 5 shows an example of the CHUEE's program structure between IFC and Shanghai Pudong Development Bank.

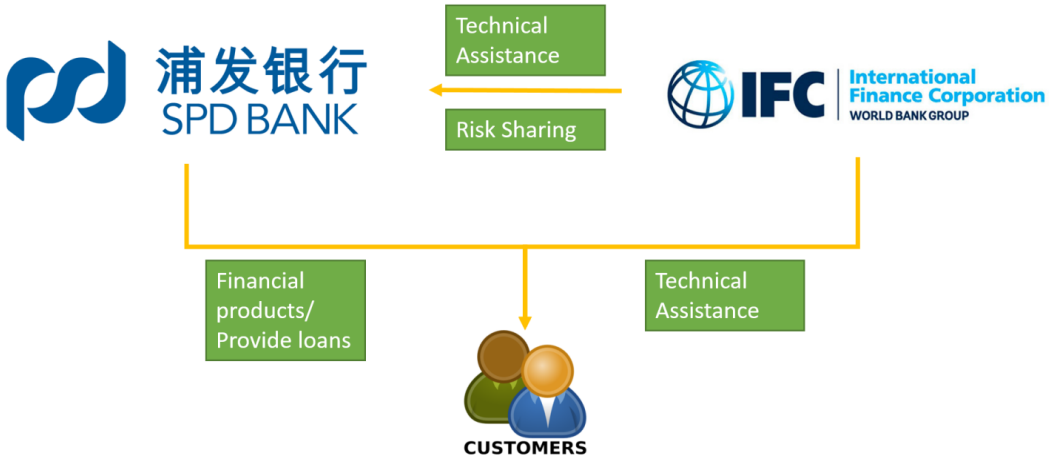

Figure 5. CHUEE program example between IFC and Shanghai Pudong Development Bank

2.3.3 Mobilize collateral

Commercial banks could offer using future shared saving income or future energy saving as collaterals. However, banks still find risks very high, as very often that collateral cannot be traded or realized (Chen, 2017; LBNL, 2016).

Two approaches can be considered to mobilize collateral for building energy efficiency loans. China is developing an Energy Savings Transaction trading market, which is similar to the carbon market, except in this market conserved energy is traded (Ricardo-AEA, 2013). This market is not yet developed, and little trading happens for building energy efficiency. If this market

mechanism can improve, it could help banks to trade “conserved energy” so that ESCOs can use future conserved energy of the project as collateral (Zhang & Liu, 2015; Chinese Institute of Engineering Development Strategies, 2016). Another approach is to make future income into asset-backed securities to trade in the market, such as the Warehouse for Energy Efficiency Loans with Renewable Funding (WHEEL) program in United States (see case study below). If shared energy savings can be turned into secured and standardized assets, it will greatly

enhance the interest of the banks, and even private equity firms or pension funds, to purchase such an asset.

2.4 Innovative government policies and programs

The role of government should be to enable the building energy efficiency market. Providing subsidies and grants, and setting up codes and standards, are all possible ways for government to enable the building energy efficiency market, with the main approach being dominated by

Program Example: Warehouse for Energy Efficiency Loans with Renewable Funding (WHEEL)

WHEEL is the first of its kind program, turning energy saving into asset-backed notes that are sold to the capital market. WHEEL was initiated in United States. It targets residential energy customers willing to invest in energy efficiency retrofits. It was conducted by the Energy Programs Consortium of Pennsylvania, the U.S. Treasury, Renewable Funding, and Citi Bank. A low-cost energy efficiency loan comes through WHEEL, a national platform for aggregation and securitization of unsecured consumer energy efficiency loans that are originated by state programs. As illustrated by Figure 6, energy efficiency loans were aggregated into a diversified pool and used to support the issuance of asset-backed notes to be sold to capital market investors (Citi, 2014).

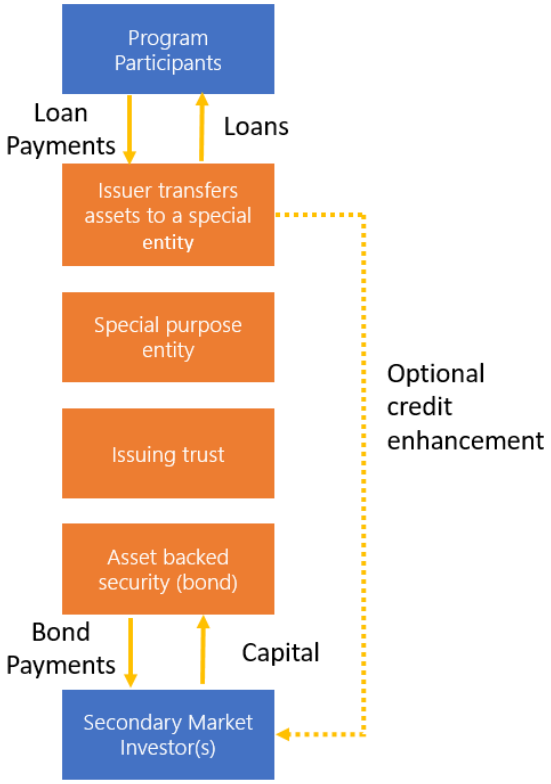

Figure 6. WHEEL's structure (Citi, 2014)

Note sales help to recapitalize WHEEL, allowing it to continue to purchase eligible loans from state and local programs for new rounds of bond issuance (Citi, 2014). Even though WHEEL is a product for single-family house owners, it definitely could apply to commercial business owners as well.

subsidies and grants. However, as seen before, subsides are not necessarily the most effective means of government spending to support an industry, as misuse of the subsidies and subsidy frauds often take place (Cui, 2017). As an alternative to subsidies, non-monetary government incentive programs, such as the U.S. Better Buildings Initiative, the government publically recognizes buildings that reached their energy efficiency improvement goals (U.S. DOE, 2017a). This approach incentives building owners to retrofit buildings and gain a positive public image.

2.4.1 Smarter government spending

Barriers it addresses: *The current subsidies- and grants-driven energy efficiency market has loopholes.*

The Chinese government intends to explore other government spending approaches, in addition to subsidies, to create a longer-term impact (Lin & Jiang, 2011). New financing approaches, such as Public-Private Partnerships (PPP) in the Thirteenth Five-Year Plan, are highly encouraged. By the end of 2016, the China Securities Regulatory Commission published a notification on turning PPP projects into securities. A large component of those projects will be in environment and energy efficiency areas (CSRC, 2016).

Two examples illustrate how PPP programs effectively enable building energy efficiency upgrades. The Chongqing government in China initiated a PPP collaboration with private company energy service Tongfang Taide and retrofitted 4 million square meters of commercial buildings. The U.S.-China Green Building Fund is another PPP structure; it uses small government investment to leverage huge private spending to achieve desirable scales of building energy efficiency upgrades (Mo, 2016), where the government's presence provides confidence for private investors to participate.

Another innovative government spending approach is one where the government pays for a portion of an interest in a building energy efficiency project, to lower interest rates to a range that debtors find attractive (IPECC, 2016). In the case of developing an insurance product, government spending can also be used for hosts or ESCOs to pay insurance premiums.

PPP Example: Commercial Building Energy Efficiency Upgrades in Chongqing, China

Chongqing, China, implemented an innovative building energy efficiency public-private partnership that successfully retrofitted 4 million square meters of commercial buildings and reduced building energy usage intensity by at least 20%. Chongqing municipal government worked with Tsinghua Tongfang, an industry expert on building energy efficiency with an excellent credit rating to initiate commercial building energy efficiency retrofit work in 2011 in Chongqing. The Bank of Chongqing agreed to lend 2 billion RMB to finance those retrofit projects. The municipal bureau offered a financial incentive of 15 RMB/square meter (m^2) for buildings that reduced energy intensity by 20%–25%, and 20 RMB/m^2 for buildings that reduced energy intensity by at least 25%, in addition to the central government's 20 RMB/m^2 subsidies. Tsinghua Tongfang contracted the projects to its subsidiary, Technovator International Ltd., and Technovator contracted the actual construction work to 30 local building energy efficiency startup companies, and engaged those companies to conduct retrofits in Chongqing, with the possibility of acquiring some of the startups after the Chongqing project. To incentivize building hosts, Technovator shared 20% of the profit with local building owners. By the end of 2015, Chongqing completed its 4 million square meters of commercial building retrofit, with 107 commercial buildings retrofitted (Schlein, Szum, Zhou, Ge, & He, 2017; Mo, 2016).

The success of the model indicated a healthy relationship among government, business, and building owners. The government works with partners that have a high credit rating, which enhances credits for banks to give out third-party financing. The government also provides an additional financial incentive after the buildings realize their promised savings, which ensures the effectiveness of the government spending. The "Chongqing model" is shown in Figure 7 (Schlein, Szum, Zhou, Ge, & He, 2017; Mo, 2016).

PPP Example: Commercial Building Energy Efficiency Upgrade in Chongqing, China (Continued)

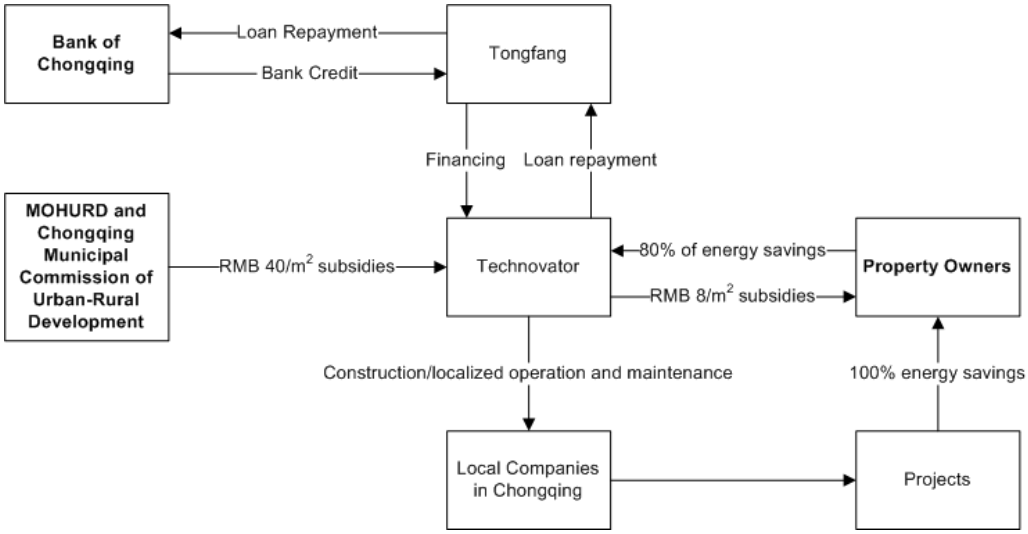

Figure 7. Chongqing commercial building energy efficiency improvement structure 2011–2015 (Schlein, Szum, Zhou, Ge, & He, 2017; Mo, 2016).

PPP Example: U.S.-China Green Building Energy Efficiency Fund

The U.S.-China Green Building Energy Efficiency Fund is an investment fund that was launched in 2015 to accelerate the deployment of U.S. technology and expertise for energy efficient buildings in China. The fund utilizes a unique public-private partnership (PPP) model (EMCA, 2017). This fund is unique because it identifies a project first and then looks for an appropriate funding mechanism and funding sources. Private firms and financial institutions from both the United States and China, as well as local Chinese governments, all played a role in putting this fund together. The local Chinese government serves as an investor and guarantor for those projects. An example that came out of the U.S.-China Green Building Energy Efficiency Fund in the city of Zhenjiang is called the Zhenjiang Green Development Industry Fund. This fund covers building energy efficiency upgrades in the city of Zhenjiang, southern Jiangsu, and the Yangtze River Delta, with a total amount of 3 billion RMB. The Zhenjiang Municipal People's Government authorized the Zhenjiang State-owned Investment Holding Group Co., Ltd. to contribute 75% to the project, and the U.S.-China Building Energy Efficiency Fund to contribute the remaining 25% (Zhenjiang government, 2016). In this approach, government leverages its credibility to help private investors to gain access to high quality building energy efficiency projects. Instead of a mere subsidy, government conducts investment to those projects with private investors, and gain a profit from those projects.

2.4.2 Creating new laws and standards to support energy efficiency upgrades

Barriers it addresses: *There is a need to expand government policy approaches to strategies other than grants and subsidies.*

Enactment of new laws can be very beneficial for supporting the building energy efficiency market. Policies and laws in the United States were essential to encourage building energy efficiency and appliance efficiency for the past 30 years. Those legislative supports include educational efforts, financial incentives, and authorized setting of energy efficiency standards (Geller, Harrington, Rosenfeld , Tanishima, & Unander, 2006). For example, in New York City's Greener, Greater Building Plan (GGBP), public buildings are mandated to disclose their energy usage data (NYCCSC, 2007). Details of the GGBP will be described in Section 2.4.3.

In the United States, building energy efficiency standards were first authorized by the law. Efficiency-related standards in United States had largely improved energy efficiency. The United States also has standards that can improve energy usage in existing buildings. For example, the Warren-Alquist Act in 1974 mandated a periodic update of Building Energy Efficiency Standards in California, and that addresses energy efficiency improvements in new construction and existing buildings both (California Energy Commission, 2015). For existing buildings, for instance, California's Title 24 standard mandates cool roof material application when an existing building conducts roof material replacement, recoating or recovering with an area of more than 50 percent of existing roof area or 2,000 ft^2 (California Energy Commission, 2017).

In China, supporting laws were also enacted for energy efficiency (Hui, 2000; Zhou, Levine, & Price, 2010). The *Energy Conservation Law of the People's Republic of China* set the foundation of creating laws to support energy efficiency. In this law, for example, actions must be taken to enhance building energy efficiency, such as mandatory heat metering for all new construction and existing buildings, and mandatory indoor temperature control systems in public buildings using air conditioning, heating, and refrigeration (Standing Committee of the National People's Congress, 2008). It is recommended to look further into creating new laws and standards to overcome barriers to building energy efficiency. For example, if a law on public building data disclosure could be passed and enforced in China, it would greatly enhance the advancement of China's building energy efficiency projects. Measurement and verification work also lacks supervision from government, and so can be of poor quality (Mao, 2017). Better regulation would help to mitigate this issue and improve data transparency.

2.4.3 Data transparency, M&V, data disclosure, and benchmarking

Barriers it addresses: *There are issues with measurement and verification, including untrustworthy M&V results due to conflict of interest and lack of M&V service quality control from the government.*

Benchmarking and data disclosure are considered very effective approaches used to address information asymmetry and motivate building owners to take actions and reduce their building

energy usage (Szum, et al., 2016). Data disclosure and transparency enable benchmarking.

Data disclosure is an important aspect in New York's GGBP, where medium to large buildings' data are used for benchmarking and analysis. Energy efficiency benchmarking, energy audits, and commissioning status reports are published online. The general public can view those data and analyzed results through New York City's government website (NRDC, 2014).

Building energy efficiency benchmarking is new in China, but it is in an experimental phase. Learning from New York City's experiences, the Changning District in Shanghai is experimenting with public building benchmarking and disclosure, and ranking building energy usage. This helps building hosts identify energy saving potentials and conduct building energy retrofits (Mao, 2017).

Despite attempts to support benchmarking and disclosure efforts in China, data transparency in China is a significant issue. Obtaining data from public buildings can be very tricky. Even data already collected by local and central governments cannot be shared for public viewing (Mo, 2016). Experiences from New York City suggest that government policies or laws that support data transparency could greatly assist the building energy efficiency industry moving forward.

Policy Example: New York's Greener, Greater Building Plan

Medium and large building use energy that accounts for 48% of New York City's total energy use. Reducing energy usage in buildings is an important part of helping New York City reach its aggressive sustainability goals. Consequently, New York City initiated a comprehensive effort—called the Greener, Greater Building Plan (GGBP)—that targets energy policy in large existing buildings (NYC, 2017).

The GGBP is an internationally recognized successful energy efficiency program that ensures information about energy use is provided to decision makers, which enables most cost-effective energy efficiency measures to be pursued. Enactment of new laws ensures program success. The GGBP has four components in the local laws (NYC, 2017):

Local Law 84: Benchmarking	Annual requirement to benchmark energy and water consumption
Local Law 85: NYC Energy Conservation Code (NYCECC)	New York City's local energy code
Local Law 87: Energy Audits & Retro-commissioning	Conduct an energy audit and perform retro-commissioning once every 10 years
Local Law 88: Lighting & Sub-metering	By 2025, the lighting in the non-residential space must be upgraded to meet code, and large commercial tenants must be provided with sub-meters

Within Local Law 84: Benchmarking, buildings are required to disclose their energy and water usage data using the U.S. Environmental Protection Agency's (EPA's) online tool, the ENERGY STAR Portfolio Manager, and use the tool to submit those data to the city. Submitted benchmarking data are also disclosed publically, and can be analyzed in reports and visualized in NYC Energy and Water Performance Map (NYC, 2017).

2.4.4 Design supporting policies or programs under a dynamically changing environment

The large Chinese political and social environment is constantly undergoing dynamic change. It is important for policy makers to acknowledge those changes and design policies that can create new opportunities for building energy efficiency market growth. For example, currently China is going through electricity market reform. It is an unparalleled opportunity to engage utility retailers in building energy efficiency upgrades. Such upgrades, where implemented properly, might significantly increase adoption in building energy efficiency upgrades.

Policy example: Electricity sector reform brings building energy efficiency market opportunities

Barrier it addresses: *Building energy efficiency-focused ESCOs have difficulty growing.*

Current electricity sector reform in China will uncouple electricity retailers from electricity transmission and distribution and create additional market opportunities for building energy efficiency and demand response (Yu, 2012; Wang D. , 2016). For example, electricity retailers will have the opportunity to approach customers and offer to provide them with customized electricity services. Many building energy efficiency programs in United States are often conducted through utilities. Before electricity sector reform in China, the monopolized electricity market had no motivation to conduct building energy efficiency programs for their consumers (Wang & Chen, 2012).

By incorporating energy efficiency upgrades as a part of their service or even becoming a host's energy manager, electricity retailers have the opportunity to avoid cut-throat competitions between other retailers and provide hosts with distinguished services (Tongfang Taide, 2017). The National Energy Administration's instruction on electricity market reform clearly indicated that government encourages ESCOs become electricity retailers and directly sell electricity to customers. In this way, as an electricity retailer, its main business is to sell electricity to customers, but it gives retailers opportunities to provide added value service, such as energy performance contracting (NEA, 2015). A potential ESCO model under electricity reform is shown in Figure 8.

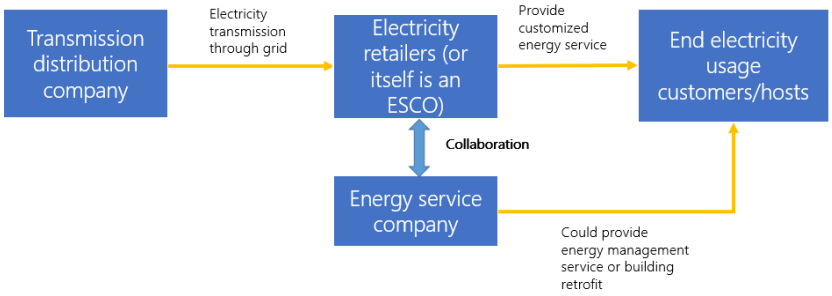

Figure 8. Hypothetical collaboration opportunities between electricity retailers and energy service companies under electricity market reform

Even though this model helps retailers gain customers, it conflicts with retailers' interests of selling more electricity to customers. The California "decoupling" model could be considered for China. In that model, a policy mechanism is designed so that an electricity retailers' income is decoupled from its actual electricity sales, and it gains rewards for helping customers become more efficient, which in turn decreases investment in electricity generation infrastructure (Moezzi, 2000; Roland-Holst, 2008; Arimura, Li, Newell, & Palmer, 2012; Levinson, 2014).

In California and some other parts of the United States, utilities are responsible for providing energy saving incentives for their customers. This greatly encourages utility companies' participation in energy efficiency (Moezzi, 2000; Roland-Holst, 2008; Arimura, Li, Newell, & Palmer, 2012; Levinson, 2014). For example, utility company PG&E has published its interest-free loan for replacing old and worn-out equipment with more energy efficient models, with loans for business owners ranging from $5,000 to $100,000, with up to five years to repay the loan. Government agencies also qualify for loans of up to $250,000 (PG&E, 2017). Similarly, electricity market reform in China might not only provide new opportunities for energy service companies, it might even provide additional financing opportunities for hosts.

2.4.5 Interdepartmental collaboration

Barriers it addresses: *Interdepartmental government policies are lacking.*

Successful building energy efficiency policy designs in United States often involve different stakeholders, such as banking administration, insurance administration, and tax administration, to work together and design sound policies. Establishing a comprehensive building energy efficiency market mechanism requires interdepartmental collaboration in China among different building energy efficiency companies. For example, commercial buildings are not a part of the National Development and Reform Commission (NDRC)'s Top Runner program yet. Encouraging the collaboration between NDRC and MOHURD to include commercial buildings as part of the Top Runner program would help to motivate commercial building hosts to reduce energy consumption themselves. Other industries, such as the electricity utility sector, have never participated in building energy efficiency upgrades in the past. Electricity sector reform is changing the market structure, making electricity retailers a possible bridge to bring building energy efficiency to hosts.

2.5 Benefit all stakeholders: Standardized building energy efficiency projects

Barriers it addresses: *A lack of standardization decreases market efficiency, there is a lack of a comprehensive M&V protocol, and commercial banks lack the motivation to finance building energy efficiency projects.*

The Chinese government should investigate mechanisms that can standardize building energy efficiency projects. One current challenge for the building energy efficiency industry is that each building is different, which requires ESCOs, banks, and other stakeholders to evaluate each building energy efficiency project individually. It would be very beneficial to create standards or market mechanisms that standardize energy efficiency projects by standardizing the documentation, contract, review and approval process, and financing process. Standardized building energy efficiency upgrade projects would greatly benefit all stakeholders, including ESCOs, hosts, financial institutions, governments, and M&V companies. For example, banks would be able to evaluate building energy efficiency projects efficiently and at scale, dramatically increasing the number of loans provided to the building energy efficiency sector (LBNL, 2016).

For example, the U.S. federal government set up the Federal Energy Management Program (FEMP) to standardize federal building energy efficiency upgrades. The program established Energy Savings Performance Contracts (ESPCs) that allow federal buildings to conduct energy

efficiency upgrades with no upfront capital costs and without having to go through a special appropriation from Congress (U.S. DOE, 2017b). Simple retrofits, such as lighting replacements or rooftop photovoltaic (PV) installation, have standardized contracts for hosts and ESCOs to adopt. In the case of rooftop PV, standardized contracts have been developed for matured business models such as power purchase agreements (PPA) and leasing models (NREL, 2013). The M&V process in IPMVP is standardized into four options: (1) Option A: Retrofit Isolation: Key Parameter Measurement; (2) Option B: Retrofit Isolation: All Parameter Measurement; (3) Option C: Whole Facility; and (4) Option D: Calibrated Simulation (FEMP, 2015). The U.S. DOE also published its Standard Energy Efficiency Data (SEED) Platform, which provides a standardized approach for public agencies and other organizations to manage energy efficiency data. It can perform functions such as data storage and management, and advanced features such as building energy efficiency data benchmarking (U.S. DOE, 2017c).

Standardization of building energy efficiency projects will benefit all stakeholders and greatly help to scale the market. Policy makers should consider creating standards and government programs and engage stakeholders to standardize building energy efficiency projects and retrofit, financing, and M&V processes (Schlein, Szum, Zhou, Ge, & He, 2017).

Policy and Program Example: Federal Energy Management Program (FEMP) and Energy Savings Performance Contracts (ESPC)

Since 1998, federal agencies have used Energy Savings Performance Contracts to procure energy savings and facility improvements without upfront capital costs. An ESPC is a partnership between a federal agency and an ESCO. The Federal Energy Management Program provides agencies with technical expert assistance and guides federal agencies to implement ESPC projects. The federal government also compiles a list of ESCO companies that are qualified to participate in ESPCs. The mechanism of the FEMP ESPCs is shown in Figure 9.

Figure 9. The mechanism of FEMP ESPCs (U.S. DOE, 2017b)

Measurement and verification is also standardized under FEMP. For example, the M&V plan for lighting energy efficiency retrofit at a Federal Center follows FEMP M&V Option A, Method LE-A-02. Variables affecting the lighting retrofit-related energy savings include fixture powers, hours of operation, and level of coincident operations. Fixture powers are measured on a sample of common fixture types. For less-common fixture types, fixture power is based on a table of standard fixture powers or manufacturer's data. Operating hours are measured based on space types identified during a detailed energy survey. Measured hours then are used to estimate energy and demand savings during the performance period, and those will not be adjusted even if actual operating schedules change. Measurement and verification Option A has been selected because the measures' cost-saving contribution of all retrofits installed at the Federal Center is small, and due to high confidence with which those fixture demand and operating hours might be determined (FEMP, 2007).

2.6 How proposed solutions help to mitigate overarching barriers

The authors have identified three overarching building energy efficiency barriers. This section describes how the solutions proposed in this report also help to address some of those overarching barriers.

Overarching Barrier 1: Building energy efficiency's internal rate of return is too low for deep retrofits, which discourages stakeholder involvement

Resolution of this issue requires systemic improvement of building energy efficiency stakeholder engagement. If building energy efficiency improvement is initiated by the host, or by property management companies, it is more likely they might conduct a building energy efficiency upgrade more systemically. In this case, accessing third-party financing would be easier, as would be supporting the retrofit project. Policies such as benchmarking and data disclosure all encourage building hosts to continue to retrofit their buildings. Therefore, even if deep retrofits require higher capital investment, a supportive ecosystem would support both hosts and energy service companies, as well as financial institutions' motivation to participate in deep retrofit.

Overarching Barrier 2: Lack of creditworthiness hinders sector growth

It will take a long time to improve creditworthiness in China. However, even before a comprehensive credit system is in place, alternative solutions, such as introducing insurance products in building energy efficiency financing, would reduce risks for banks to finance building energy efficiency products, even if creditworthiness issues still exist. Providing hosts and property management companies with technical education and introducing them to suitable and qualified energy service providers (through strategies such as following EMCA's ESCO company rating system) will improve the quality of the energy efficiency service. If hosts/property management companies can initiate third-party financing, or finance from their own cash flow to support building energy efficiency upgrades, they can reduce the risk that ESCOs will encounter untrustworthy hosts who are unwilling to pay for energy saved through a shared saving model.

Overarching Barrier 3: Lack of systematic diagnostics, planning, and market consolidation

By encouraging host and property management companies to become market drivers, and by reducing barriers for third-party financing, it is more likely that hosts or property management companies would choose building energy efficiency retrofit services based on their own needs. The key is to turn the current competitive (but lower quality) building energy efficiency market into a healthy and consolidated market where there can be a significantly increased number of building energy efficiency upgrade business deals.

3 Conclusion

This report outlines several potential solutions that could help to overcome the barriers to increasing the market for building energy efficiency improvements in China that were identified in Part 1 of this study. Each stakeholder has its own distinctive interests, and currently those interests are not well aligned. The situation has resulted in a failure of the current market structure, where:

- ESCOs consider building energy efficiency as a difficult market in which to gain a profit;
- hosts are not able to see the large potential benefits for conducting building energy efficiency retrofits;
- financial institutions consider building energy efficiency project financing high-risk and low-return, and are unwilling to participate;
- property management companies do not see a role for them to play in building energy efficiency upgrades,
- M&V companies only care about satisfying their customers' (often energy service providers) requirements, instead of providing trustworthy energy saving numbers; and
- government subsidies and grants are used to incentivize building energy efficiency upgrades, but they contain loopholes and do not provide for a sustained market.

In this report, it is suggested that policies and government programs should be developed in order to build a comprehensive supporting ecosystem for other stakeholders, as well as ESCOs. Policies and government programs should be designed to increase host motivation, decrease risk for financial institutions, encourage property management company involvement, encourage M&V companies to provide trustworthy results, and eventually create government policies that are cross-departmental and more effective.

Those solutions can be summarized as follows:

Solution 1 – Provide a supportive ecosystem for hosts to motivate them: Build a supportive policy ecosystem with government programs, customer education, suitable building energy efficiency financial products for hosts, and energy service providers that help to transition from an ESCO-oriented market to a host-oriented market.

Solution 2 – Provide a supportive ecosystem for property management companies to motivate them: Build a supportive policy ecosystem that supports and promotes a property management company-oriented energy efficiency market, including property manager education and providing incentives to support property manager-driven energy efficiency business models such as Property Energy Management (PEM).

Solution 3 – Help financial institutions lower loan risks for building energy efficiency projects: Create government programs such as loan reserves that can lower financial institutions' loan risks in building energy efficiency. This approach would motivate financial institutions to provide low interest loans to building energy efficiency projects.

Solution 4 – Create innovative government policies: Innovate government policies by encouraging more effective government spending, creating new laws and standards to support energy efficiency upgrades, and encouraging data transparency. Interdepartmental collaboration can facilitate more comprehensive policies. Policy design should also consider the changing social environment. For example, ongoing electricity market reform has created significant opportunities for the building energy efficiency market. Supporting policies should consider how to best adapt the opportunity to scale-up

building energy efficiency retrofits in China.

Solution 5 – Standardize building energy efficiency projects would benefit all stakeholders: Standardized building energy efficiency projects help to create unified measurement and verification protocols. Such standardization also helps commercial banks to evaluate building energy efficiency projects fast and in scale.

This research provides an introductory solution package for Chinese decision makers and relevant stakeholders to consider overcoming current barriers and scaling up building energy efficiency upgrades in China. Policy makers in China should consider actual applications when implementing some of the suggested solutions and adjust them accordingly.

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